INTRAOCULAR LENS AND METHOD OF FORMING THE LENS

FIELD OF THE INVENTION

The invention relates to intraocular lenses. The lens comprises a soft, resilient polymeric optical element and a resilient polymeric support embedded therein and having outwardly extending mounting arms. The support is embedded in the optical element during molding of the optical element.

BACKGROUND OF THE INVENTION

Artificial intraocular lenses, used to replace damaged or diseased natural lenses in the eye, have been widely used in the last several years. Typically, such artificial intraocular lenses comprise some type of optical element and a support coupled to the element for positioning the optical element in the proper location in the eye.

These lenses have typically included hard polymeric or glass optical elements with metallic or polymeric supports. One problem with hard lenses is that the incision in the eye to insert them must be at least as large as the diameter of the optical portion of the lens. Thus, the patient must experience a fairly traumatic large incision.

Use of soft, foldable polymeric lenses is hampered because it is difficult to support them and it is difficult to insert them into the eye.

Another problem involving either hard or soft intraocular lenses is the need for adhesives or extra, complicated steps to connect the supports to the optical element.

Thus, there is a continuing need for improvement in intraocular lenses.

Examples of such prior art intraocular lenses are disclosed in the following U.S. patents: U.S. Pat. Nos. 2,834,023 to Lieb; 4,159,546 to Shearing; 4,172,297 to Schlegel; 4,206,518 to Jardon et al; 4,242,760 to Rainin; 4,253,200 to Kelman; 4,257,130 to Bayers; and 4,363,143 to Callahan.

SUMMARY OF THE INVENTION

Accordingly, a primary object of the invention is to provide an intraocular lens having a soft, resilient optical element and a resilient support, both of which are foldable for easy insertion into the eye via a small incision, and having a support more rigid than the optical element to ease insertion and to prevent collapse or distortion of the optical element after insertion into the eye.

Another object of the invention is to provide such an intraocular lens that avoids the use of adhesives or numerous steps to couple a support to the optical element.

Another object of the invention is to provide an intraocular lens that is comprised of a soft, resilient polymeric optical element and a resilient polymeric support embedded therein during molding of the optical element.

The foregoing objects are basically attained by providing a method of making an intraocular lens comprising the steps of forming a resilient support including an annular portion and mounting arms, positioning a portion of the support in a mold, molding an optical element in the mold including introducing material forming the optical element into the mold in liquid form and surrounding the portion of the support in the mold with such material forming the optical element, converting the material forming the optical element from liquid form into solid form, and removing the intraocular lens formed by the support and the optical element from the mold.

The foregoing objects are also attained by providing an intraocular lens comprising a resilient optical element; and a resilient support having an annular portion and mounting arms, the annular portion being embedded in and surrounded by the material forming the optical element, the mounting arms extending outwardly of the material forming the optical element.

Other objects, advantages and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment of the present invention.

DRAWINGS

Referring now to the drawings which form a part of this original disclosure:

FIG. **1** is a top plan view of the intraocular lens in accordance with the invention including an optical element and a support embedded therein;

FIG. **2** is a top plan view of the support for the optical element including an annular portion and a pair of mounting arms, without the optical element coupled thereto;

FIG. **3** is an enlarged right side elevational view in section of the intraocular lens in accordance with the invention taken along line **3—3** in FIG. **1**;

FIG. **4** is a front elevational view in section taken along line **4—4** in FIG. **1** showing a portion of the support embedded in and surrounded by the optical element;

FIG. **5** is a side elevational view, in partial section, of the support having a portion located in a mold and the optical element surrounding that portion of the support in the mold; and

FIG. **6** is a top elevational view in section taken along line **6—6** of FIG. **5** showing the bottom half of the mold as well as the optical element and the support.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIGS. **1-4**, the intraocular lens **10** in accordance with the invention comprises a soft transparent optical element **12** and a support **14**, both of which are flexible and resilient, and therefore bendable or foldable. As seen in FIGS. **3** and **4**, a portion of the support is embedded in and surrounded by the optical element. This is accomplished by inserting a portion of the support in a mold and molding the optical element around that portion of the support, as seen in FIGS. **5** and **6**. The support is more rigid than the optical element to provide the necessary structural suspension of the optical element when placed in the eye.

The support **14** comprises an annular portion **16** and a pair of curved mounting arms **18** and **20** rigidly coupled thereto and extending initially substantially tangentially thereof on diametrically opposed sides. The arms and annular portion are coplanar, although the tips of the arms can be bent out of the plane of the arms and annular portion to provide for better connection in the eye. Advantageously, the support is about 13 millimeters long and the annular portion **16** is about 5.5 millimeters in diameter. In cross section, the support material is circular. The thickness of the material forming the annular portion and mounting arms is preferably uniform